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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,881	06/25/2003	Christopher Formato	50103-480	2261

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EXAMINER
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YOUNG, CHRISTOPHER G

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 06/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/602,881

Applicant(s)

FORMATO, CHRISTOPHER

Examiner

Christopher G. Young

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 15 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) 11-16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4,8 and 17 is/are rejected.
- 7) ☒ Claim(s) 5-7,9 and 10 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 1 sheet.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Election/Restrictions***

1. Claims 11-16 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on April 15, 2005.

### ***Drawings***

2. New corrected drawings in compliance with 37 CFR 1.121(d) are required in this application because the current drawing sheets are of a poor quality. Formal drawings that are not free-hand should be submitted. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1, 3, 4, 8 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Watanabe, US Patent Number 6,372,389.

The instant application claims are drawn to a method of forming a topographical pattern in a surface of a resist layer as set forth in claim 1.

The prior art teaches in the first embodiment, a negative resist film 2 is first formed on a substrate 1 through spin coating or another method, as shown in FIG. 2A. The substrate 1 is a silicon substrate, for instance. The negative resist film 2 is made of chemically amplified negative resist, is about 0.5  $\mu\text{m}$  thick, and is prebaked (PB) at about 110.degree. C., for instance. However, the materials, thickness, and processing temperature of the substrate 1 and the negative resist film 2 are not limited to those described above. In addition, a positive resist film may be used instead of the negative resist film 2. Next, as shown in FIG. 2D, developing solution is supplied to remove the unexposed portions of the negative resist film 2. The developing solution may be supplied by directing jets of developing solution through a nozzle or by submerging the substrate in the developing solution, for instance. The developing solution is, for example, a 2.38% tetramethylammonium hydroxide (TMAH) developing solution, which is an alkaline developing solution. The developing time is about 60 seconds, for instance. However, the developing solution and developing time are not limited to those indicated above. FIGS. 4A and 4B are diagrams showing schematic views of a pattern formed through the rinsing step in which ultrasonic vibration is applied (pattern formed according to the first embodiment) and a pattern formed through the rinsing step in which no ultrasonic vibration is applied (pattern formed by the conventional method). In

the experiment for forming the pattern shown in FIG. 4A, the silicon substrate is applied with a layer of commercially available chemically amplified negative resist of about 0.5  $\mu\text{m}$  thick, a resist film is formed through the PB processing at about 110.degree. C. and exposed to light of about 23  $\text{mJ}/\text{cm}^2$ , then the PEB processing is performed at about 105.degree. C. In the developing step, a 2.38% TMAH developing solution is used as the alkaline developing solution, and a developing time of about 60 seconds is taken. In the rinsing step, the wafer is submerged in the pure water, and ultrasonic vibration of about 40 kHz to 50 kHz is applied. The compared example shown in FIG. 4B is formed by applying a layer of commercially available chemically amplified negative resist of about 0.5  $\mu\text{m}$  thick on a silicon substrate, forming a resist film through the PB processing at about 110.degree. C., exposing to light of about 23  $\text{mJ}/\text{cm}^2$ , and performing the PEB processing at about 105.degree. C. In the developing step, a 2.38% TMAH developing solution is used as the alkaline developing solution, and a developing time of about 60 seconds is taken. In the rinsing step, the wafer is submerged in the pure water, and no ultrasonic vibration is applied. This experiment proves that the generation of microbridges is suppressed by performing ultrasonic processing during rinsing.

In the description above, the ultrasonic processing is performed in rinsing only, but the ultrasonic processing may be performed during the developing step.

5. Claims 1 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Chiu, US Patent Number 5,876,875.

The instant application claims are drawn to a method of forming a topographical pattern in a surface of a resist layer as set forth in claim 1.

Referring to the prior art, FIG. 1, Block 105 shows applying an ultrasonic wave through the use of an ultrasonic wave generator, which couples the ultrasonic wave into the semiconductor wafer, Block 106, and causes the pattern on the substrate to vibrate laterally (Block 107). This vibration once more causes agitation, Block 103, of the developing liquid and enhances its solution diffusibility, Block 104.

6. Claims 1, 2 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Jurgensen et al., US Patent Number 4,652,106.

The instant application claims are drawn to a method of forming a topographical pattern in a surface of a resist layer as set forth in claim 1.

The prior art shows that when developing a coating such as for instance a light-sensitive exposed layer on a length or plate of material through ultrasonic agitation, the material is carried at a short distance or closely past a bar or a pipe extending substantially perpendicular to the advancing direction of the material and in the entire width of the coating. The bar or the pipe is caused to vibrate by a plurality of ultrasonic transducers while a developer is applied onto the coating adjacent the bar or the pipe in such a manner that the vibrations are transferred from the vibrating bar or pipe to the developer and to a stripe-shaped transverse area of the plate/the length including the coating. In this manner only the part of the developer having touched the ultrasonically agitated pipe or bar or already having hit the stripe of material currently developed is

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caused to vibrate by the ultrasonic transducers. Consequently, it is not necessary to involve an equally great power through the ultrasonic transducers as in connection with known apparatuses using a great tank with ultrasonically agitated liquid in which the entire plate/length is immersed.

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe, US Patent Number 6,372,389.

The broad claim has been rejected by this reference as set forth above. The prior art does not show the specific materials utilized as the substrate material. However, these are all well-known substrate materials as shown in some of the other prior art references of record. See Jurgensen et al. as an example. A skilled artisan would have found it prima facie obvious to utilize well-known substrate materials in the method disclosed by Watanabe with a reasonable expectation of achieving the same beneficial results taught therein.

9. Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chiu, US Patent Number 5,876,875.

The broad claim has been rejected by this reference as set forth above. The prior art does not show the specific materials utilized as the substrate material or the specific types of exposure and resist materials utilized. However, these are all well-known substrate materials, and resist materials, as shown in some of the other prior art references of record. See Jurgensen et al. as an example for substrate materials. See Watanabe for use of positive and negative working resist materials. A skilled artisan would have found it prima facie obvious to utilize well-known substrate materials, and resist materials, in the method disclosed by Chiu with a reasonable expectation of achieving the same beneficial results taught therein.

10. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jurgensen et al., US Patent Number 4,652,106.

The broad claim has been rejected by this reference as set forth above. The prior art does not show the specific materials utilized as the resist materials. However, these are all well-known resist materials, as shown in some of the other prior art references of record. See Watanabe for use of positive and negative working resist materials. A skilled artisan would have found it prima facie obvious to utilize well-known resist materials in the method disclosed by Jurgensen et al. with a reasonable expectation of achieving the same beneficial results taught therein.



***Allowable Subject Matter***

11. Claims 5-7, 9 and 10 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Conclusion***

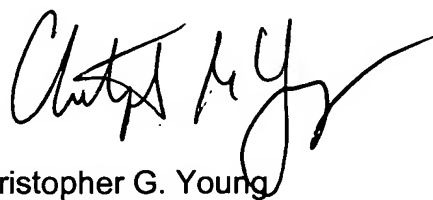
12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Asakawa et al., US Patent Number 6,565,763 teaches that since a block copolymer has two or more kinds of polymers linked through a chemical bond, the block copolymer is generally hard to be developed even if one polymer chain represents high solubility to a developer. However, when a block copolymer of polystyrene (PS) and polymethyl methacrylate (PMMA), for example, is irradiated with an electron beam, the main chain of PMMA is cut, so that only the PMMA phase can be dissolved in the developer. The developer is not particularly restricted as long as it can selectively dissolve out to remove the decomposed polymer chain, and therefore it may be a water-based solvent or an organic solvent. In the case of PMMA, methyl isobutyl ketone (MIBK), ethyl lactate, acetone, etc., can be employed. In order to adjust the solubility of the polymer, other solvent such as isopropyl alcohol (IPA) may be added to the developer as well as a surfactant may be added. Ultrasonic cleaning may be performed during development. Since the polymer chain after decomposition is lowered in molecular weight and can be evaporated by heat treatment, it can be easily removed.

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13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher G. Young whose telephone number is 571-272-1394. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Christopher G. Young', with a long, sweeping horizontal stroke extending to the right.

Christopher G. Young  
Primary Examiner  
Art Unit 1756

cgy